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UNCLASSIFIED INFORMATION ON SOVIET BLOC INTERNATIONAL GEOPHYSICAL COOPERATION - 1960

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INTERNATIONAL GEOPHYSICAL COOPERATION PROGRAM -- SOVIET-BLOC ACTIVITIES

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I. GENERAL

Soviets Review the Field of Volcanology

The First All-Union Volcanological Conference was held in Yerevan between 23 September and 2 October 1959. It was attended by representatives of 86 different geological or closely allied institutions. Inasmuch as this was the first conference of its type, its purpose was the clarification and evaluation of the present-day status of volcanology in the USSR, the pointing up of underdeveloped aspects of the field and the working up of recommendations concerning future research on the most important theoretical and practical problems of volcanology.

Conference reports were devoted to problems of the study of present-day and ancient vulcanism in the USSR and many associated subjects.

The conferees agreed that one of the important tasks of Soviet geological science is the expansion of paleovolcanological research for the purpose of recreating the history of vulcanism and finding the laws governing it.

The problem of the role of vulcanism in the evolution of the Earth and its geological history is closely associated with the problem of cosmic vulcanism and the comparative study of the system Moon-Earth. The assembled scientists noted the need for a closer working relationship between volcanological and astronomical research.

The conference devoted considerable attention to the matter of volcanological provinces and formations and the mineral deposits associated with them. Also discussed were the basic differences in volcanological manifestations on island arcs, on continental coasts and in regions deep within the continents.

During the conference a symposium was held on the subject of classification, nomenclature and terminology; primary attention was devoted to the classification of pyroclastic rocks, a matter of heated dispute. The solution of this problem is very important for geological work, which badly needs a unified classification. The problem was delegated to a special committee.

The conference demonstrated the great value of contact between volcanologists, structural geologists, petrographers, geochemists, geophysicists, physical chemists and astronomers. It was recommended that such contact be increasingly expanded and intensified.

During the conference those present participated in field trips for familiarization with the various volcanological formations of Armenia.

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The conference earmarked the following as the basic directions in volcanological research: the study of the laws of development of present-day and ancient vulcanism in the USSR, the discovery of the laws of formation and areal distribution of minerals associated with vulcanism; clarification of the Earth's geothermal regime and ways to make practical use of deep heat; research in the field of prediction of volcanic eruptions and volcanological regionalization for the purpose of warning the population of threatening danger; the study of vulcanism as a planetary and cosmic phenomenon, especially vulcanism on the Moon and planets.

For a discussion of the individual problems of volcanology it was decided to hold special symposia on an annual basis. The next volcanological conference is planned for 1963 in Petropavlovsk-on-Kamchatka. ("Important Problems of Volcanology", by Professor V. I. Vlodavets, Vestnik Akademii Nauk, No. 1, pp. 106-108)

Academician Bardin Reviews the Accomplishments of the International Geophysical Year

In a nine-page article appearing in the January 1960 issue of the Vestnik of the Academy of Sciences of the USSR, Academician I. P. Bardin presents an impressive enumeration of the accomplishments of the IGY between 1 July 1957 and 31 December 1959.

"There is no doubt", he states, "that the IGY was of revolutionary significance in both scientific and organizational respects. It opened new horizons in the various fields of geophysics and allied disciplines and has brought many branches of science closer together by the setting of common goals. It has yielded a series of unexpected discoveries and basically changed many ideas that had prevailed two or three years earlier".

"The conclusions which are being drawn from even the first preliminary scientific results of the IGY, decidedly demand that the system of daily geophysical observations organized in connection with the IGY be maintained and brought into correspondence with the new tasks standing before the field of geophysics".

"Despite the fact that the processing and refinement of IGY data is still far from completed, we have already received many interesting results of great theoretical and practical significance".

Bardin then runs down a checklist of the important discoveries of the IGY period, such as: the discovery of belts of charge particles, "magnetic traps", around the Earth; the use of artificial earth satellites and rockets in conjunction with earth stations and observatories for the determination of characteristics of the upper atmosphere; research on the Sun's ultraviolet and Roentgen radiation; investigation of the concentration of meteoric matter in space; study of atmospheric whistlers; observations of zodiacal light; examination of micropulsations of the Earth's magnetic field and earth currents. Such research, he points out, has already enabled us to make some wide generalizations about the structure, composition and evolution of the Earth.

Bardin then points out a number of other accomplishments in the fields of atmospheric physics, geomagnetism, oceanography, Arctic and Antarctic research, meteorology, glaciology, seismology, etc.

"In the Soviet Union", he adds, "18 government departments and 90 scientific institutions and colleges participated in this research. Their activity has been coordinated and controlled by the Soviet Committee of the International Geophysical Year".

"Our primary concern", he continues, "should now be the preservation and utilization of all the data acquired by the intense and self-sacrificing work of many thousands of geophysicists during the period of the IGY. The receipt of such a quantity of varied data is without precedent. The analysis and generalization of these data will require many years of work and close international scientific cooperation".

"One of the world centers for the collection, storage and dissemination of IGY data is situated in Moscow. It consists of two subcenters. One of them is for data of a complex of electromagnetic phenomena, while the other is for data on meteorology, longitude and latitude, glaciology, oceanography, seismology, gravimetry and radiation".

"These subcenters have the microfilming and photocopying facilities and computers necessary for the duplication and computation of the data received. The world centers are obligated to send copies of observational data at the request of scientists of other IGY participating countries".

"The world center provides conditions for the familiarization of Soviet and visiting foreign scientists with the whole range of observational data received from IGY participating countries. These data appear on hundreds of kilometers of film and in millions of tables".

"The center not only handles the exchange of primary data, but the exchange of publications as well. Soviet IGY publications are sent to more than 200 addressees in 60 countries; the publications of other countries are received in exchange. In 1959, for example, more than 400 titles from 30 countries were received. The IGY, moreover, has facilitated the establishment of close contacts between Soviet scientists and the scientists of other countries".

"It is now essential to maintain at stations, in observatories and on expeditions that level of observations that was attained in 1959. It is necessary to devote special attention to the successful completion of the complex work of the IGY. We cannot forget the sad experience of the Second International Polar Year (1932-1933), when insufficient attention was devoted to this stage for a number of reasons and the immense expenditures on observations proved to have been to a considerable extent in vain".

Bardin then concludes: "The timely publication of IGY data is one of the principal tasks of the present time. In view of the tremendous value of IGY data their publication should be placed on a priority basis". ("The Great Success of International Cooperation by Scientists", by Academician I. P. Bardin, Vestnik, Akademii Nauk SSSR, No. 1, 1960, pp. 13-21)

East German Institute Monitors Radioactivity

An article in the East German newspaper Der Morgen of 20 February discusses the alleged increase in radioactive contamination as a result of nuclear tests conducted by the West. The article states that the East German Institute for Research on Dust and Radioactive Suspended Matter (Institut fuer Staubforschung und radioaktive Schwebstoffe), located in Berlin-Friedrichshagen, has been measuring radioactive fallout since 1956 in cooperation with the Meteorological and Hydrological Service. ("We Are Not Powerless Against Radioactive Rain," by Major Guenter Huschek; Berlin, Der Morgen, 20 Feb 60, p 2)

II. ROCKETS AND ARTIFICIAL EARTH SATELLITES

Soviet Writer Reviews Soviet Scientific Advances in Outer Space

Writing in the popular Soviet publication Nauka i Zhizn', B. Danilin presents a brief review of Soviet accomplishments in outer space. The list of accomplishments is impressive but sketchy, and the list contains nothing not reported many times elsewhere in great detail. The title of the article "On the Eve of New Discoveries" suggests that the author will prognosticate future Soviet developments, but he essentially limits himself to expressions of buoyant optimism and confidence in Soviet leadership in this field. ("On the Eve of New Discoveries", by B. Danilin, Nauka i Zhizn', No. 2, 1960, p. 10)

III. UPPER ATMOSPHERE

Study of Comets and Meteors Expanding in the USSR

The following is the full text of a recent report on expanding Sodet interest in the study of comets and meteors:

The study of meteoric matter is presently taking on considerable practical interest in connection with the rapid progress in mastering outer space. The use of instruments carried beyond the limits of the Earth (in artificial earth satellites, rockets and other vehicles) for the study of meteoric matter is opening up completely new prospects in this field.

At a plenary session of the Commission on Comets and Meteors held in Khar'kov on 25-28 September 1959 a significant part of the reports and papers delivered were devoted to the results of observations of meteors in the period 1957-1959. During these years there has been a sharp increase in the level of Soviet meteor astronomy. The establishment and activation of radar equipment (at Tomsk, Khar'kov and Kazan') made it possible to conduct observations of meteoric activity as included in the program of the International Geophysical Year. Effective photographic equipment was also designed and built (at Odessa and Stalinabad). High-quality photographs of meteors were made at a number of meteor stations; their processing yielded important data concerning the atmosphere in the meteor zone. Several astronomical observatories and stations (Ashkhabad, Kiyev, Stalinabad, Simferopol') successfully carried out a program of visual observations of meteors.

Reports devoted to the interpretation of observational data included studies of problems dealing with the distribution of meteor reflections by time, photometric problems dealing with meteors, the structure of meteoric showers by radio observations, the drift and diffusion of meteor trails, the density of meteoric matter, the determination of the form of radar lobes, and others.

In discussing the results of observations of recent large comets (Institute of Astrophysics of the Academy of Sciences of the Tadzhik SSR) it was pointed out that large instruments are needed for such observations.

The plenary session worked out recommendations for the future development of meteor and comet astronomy in the Soviet Union.

Among the concrete measures recommended by the plenary session were: the organization of a permanent radar patrolling of meteoric activity (at Kiyev, Kazan', Tomsk, Irkutsk, Stalinabad), the development of a new method and radio equipment (at Khar'kov, Tomsk, Kazan',

CPYRGHT

Odessa, Ashkhabad) and the use of modern computers for the processing of observations. It was pointed out that meteor stations should be equipped with supersensitive cameras. The need was recognized for the close coordination of all kinds of research accomplished in outer space. It was recommended that this coordination responsibility be delegated to the Institute of Applied Geophysics of the Academy of Sciences of the USSR.

A new membership list of the Commission was selected, headed by V. V. Fedynskiy. ("The Study of Comets and Meteors," by I. T. Zotkin, Vestnik Akademii Nauk SSSR, No. 1, January 1960, p. 96)

Study on the Energy Distribution in the Spectrum of the Counterglow

The results of the first attempt of studying the continuous spectrum of the counterglow are contained in an article in a Soviet scientific periodical. The observations were made in the spectral region from 4,200 to 6,520 Å with a high power nebular spectrograph at an altitude of 3,000 meters near Alma-Ata (43 N). The energy distribution of the counterglow for 4 nights was obtained. The contrast of the continuous spectrum of the counterglow at antihelion in relation to the sky background is 12%, the mean for 4 nights and all wavelengths. This contrast varies strongly from night to night and possibly with wavelength. Thus, the contrast almost equalled zero on one night but 5 days later, when an aurora was seen the first half of the night, the contrast was on the average 20%. A comparison of the energy distribution near the antihelion with that in the spectrum of Zodiacal light showed that on the average, the energy distribution in the spectrum of the counterglow was very close to that in Zodiacal light at a distance of 40° from the sun and consisted of about 8.5% of the latter.

In the 4,300-4,400 Å region an excess emission of unknown origin was found. Values of the absolute spectral brightness of the counterglow which are given were found by reference to a standard radioactive luminofor recorded simultaneously by the spectrograph. ("Energy Distribution in the Spectrum of the Counterglow," by N. N. Pariyskiy and L. M. Gindilis, State Astronomical Institute imeni P. K. Shternberg, Institute of the Physics of the Earth Academy of Sciences USSR; Moscow, Astronomicheskiy Zhurnal, Vol 36, No 6, November-December 1959, pages 1078-1090)

New Planetarium in Caucasus

The first planetarium in the northern Caucasus has been set up in Pyatigorsk. It was created with the aid of workers from the Moscow Planetarium. ("In a Few Lines"; Moscow, 2 March 1960, p 6)

New Book on Planets

A new book, Efemeridy malykh planet na 1960 g. (Ephemerides of Small Planets for 1960), has been issued by the Institute of Theoretical Astronomy, Moscow-Leningrad.

The book contains the elements of 1630 small planets; the opposition dates of the planets; the ephemerides of 1233 planets whose oppositions for the most part take place in 1960; the ephemerides for physical observations of bright planets; and tables describing the state of observations on 1 January 1959. ("New Books;" Vestnik Akademii Nauk SSSR, No 1, January 1960, p 129).

Observations of Peripheral Sun Spots in the H_{alpha} to H_{delta} Balmer Lines

Recently A. B. Severny and V. Bumba [Severny, A. B. and V. Bumba, On the penetration of solar magnetic fields into the chromosphere. The Observatory Vol 78, 1958, page 33] and W. Mattig [Mattig, W. Observations of peripheral sun spots in $H\alpha$. Naturwissenschaften (Natural Sciences) Vol 45, 1958, page 104] observed independently of each other that in the spectrograms of peripheral sun spots these are shifted toward the sun's periphery within the core of the hydrogen line $H\alpha$ in comparison with the adjacent continuum. Since the cores of strong Fraunhofer-Lines are formed at greater heights (chromosphere) than the surrounding continuum (photosphere), such a "peripheral shift" of the sun spots is understandable. This, of course, is also true for the undisturbed layers of the sun's atmosphere, but cannot be observed directly geometrically since the undisturbed atmosphere does not possess any discreet points which reveal themselves at the periphery during the projection effect. The height of the absorbing layer in the center of $H\alpha$ is given as 2000 km [Severny, A. B. and V. Bumba, ibid] or 1700 km [Mattig, W., ibid]. This height is considerably smaller than that in the undisturbed atmosphere, for which C. de Jager gives 3500-5000 km [Jager, C. de, The interpretation of hydrogen spectroheliograms. Bull. Astr. Inst. Netherlands Vol 13, 1957, page 133]. C. de Jager calculated the mean emission heights of the Balmer Lines $H\alpha$ to $H\delta$ from chromosphere models. Inversely, assertions concerning several conditional parameters in the chromospheric layers of the sun spots may now be made from the determination of the formation heights. After it had been determined that the "peripheral shift" occurs in all Balmer Lines, observations of peripheral sun spots in the Balmer Lines $H\alpha$ to $H\delta$ were carried out on the Einstein Tower in the summer of 1958.

The spectrograms of the sun spots were recorded in the 4th, 5th and 6th order of the Leningrad grating [Mattig, W. and E. H. Schroter, Test results on a high light-intensity diffraction grating with "blaze"-action. Optik (Optics) Vol 16, 1959, page 339 Mitt. Astrophys.

Obs. Potsdam (Reports of the Astrophysical Observatory, Potsdam) No 767 i.e., with high linear dispersion and high spectral resolving power. Illus. I shows an example the "peripheral shift" in Hβ. The measurement problem consisted of determining the pertinent difference in the positions of the sun spot within a line with respect to the surrounding continuum as a function of the wavelength. The "peripheral shift" is usually less than 2000 km; i.e. the maximum shifts measured were about 0.2 mm. Five sets of observations of four different large sun spots were measured. For each of the Balmer Lines curves are obtained which are similar to those given in /Mattig, W. Observations of peripheral sun spots in Hα, ibid 7. Table I indicates the mean values of the mean heights h* in the various lines and the mean wavelength differences $\Delta\lambda_H$ for half a shift (analogous to a half-value width in the case of linear contours).

Table I

Line	h* /km/	$\Delta\lambda_H$ /Å/
Hα	2155 ± 190	0.91 ± 0.03
Hβ	1465 ± 180	0.48 ± 0.04
Hγ	1130 ± 145	0.39 ± 0.01
Hδ	815 ± 115	0.32 ± 0.04

These observational results now permit assertions to be made, with certain assumptions, about two magnitudes which characterize the chromosphere above sun spots. For this purpose we reverse the process used by C. de Jager /ibid/ for calculation of the mean emission heights of Balmer Lines. This should be a good first approximation for obtaining any information at all about the chromosphere of sun spots. We assume that the measured height h* (λ) in the chromosphere corresponds to the optical depth $\tau_v = 1$, i.e.

$$\int_{h^*}^{\infty} k_{\Delta\lambda}(h)dh = 1$$

where $k_{\Delta\lambda}$ is the wavelength-dependent absorption coefficient per cm^3. If we further assume that the cores of the Balmer Lines are expanded only as the result of thermal Doppler effect and turbulence, then the absorption coefficient will contain only the number of atoms in the second quantum state n_2 and the Doppler width $\Delta\lambda_D$ in addition to the usual atomic constants. Here n_2 characterizes the maximum amount of "peripheral shift" and $\Delta\lambda_D$ the wavelength dependence. Within the framework of the approximated theory we can consider the solar atmosphere as a plane parallel layer and can neglect the fact that radiation from the sun spots also permeates through layers of the undisturbed atmosphere. From the maximum amounts of "peripheral shift" in the centers of the four different Balmer Lines we obtain $\frac{n_2(h)}{\Delta\lambda_D(h)}$, and from the curve of "peripheral shift" as a function of λ within the individual lines we obtain $\Delta\lambda_D(h)$. Instead of $\Delta\lambda_D$ we used $\xi_0 = \frac{c}{\lambda}\Delta\lambda_D$ for physical interpretation. Thus we can make separate assertions about $n_2(h)$ and $\xi_0(h)$. A height decrease of n_2 is obtained if h_0 is counted as positive toward the outside. With $h_0 = 1000$ km, $\log n_2 = 5.3$, at $h_0 = 2500$ km on the other hand, $\log n_2 = 3.6$. The gradient $\alpha = \frac{d \ln n_2}{dh}$ is throughout greater than in the undisturbed chromosphere. The value ξ_0 determined from kinetic temperature and turbulence is on the average somewhere near 12 km/s ($h_0 = 1500$ km) with a tendency to rise slowly towards greater heights. The thermal and turbulent components cannot be separated at first, so that no data could be given about the electron temperature. The zero point of the height scale ($h_0 = 0$) is based as usual on the point at which the radial optical depth of continuous radiation is approximately $\tau_0 = 0.005$.

A comparison of these spot data with those of the undisturbed chromosphere is rendered difficult by two circumstances. Data about $n_2^{\circ}(h)$ for the undisturbed chromosphere differ among the various authors up to two orders of magnitude (factor 100); the geometric zero-point difference between spot and photosphere, i.e. the geometric depression of the sun spots is not known. Therefore, qualitatively we will say only that $n_2^{*}(h)$ is ordinarily smaller than $n_2^{\circ}(h)$, if the comparison is made with the most probably chromosphere models; the same is also true for ξ_0^{*}. From this it follows that even in the chromospheric layers $T^{*} < T^{\circ}$. Since large sun spots are clearly recognizable on every spectroheliogram, this is to be expected.

In closing we wish to make reference to an additional observational disclosure. The sun-spot spectra show the same shift towards the periphery in the metal lines as the Balmer Lines (illus 2). The shift amounts to several hundred up to a thousand kilometers. Obviously the cores of the metal lines form in the sun spots at greater heights than in the undisturbed atmosphere. This is understandable qualitatively since in the case of neutral metals more atoms are available in the spots for absorption due to lesser ionization than in the undisturbed atmosphere.

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FIGURE APPENDIX

Figure 1. Spectrum of a peripheral sun spot at λ = 4861 Å with "peripheral shift" in H_β

Figure 2. Spectrum of a peripheral sun spot at λ = 4338 Å with "peripheral shift" in the metal lines.

("Observations of Perepheral Sun Spots in the H_{alpha} to H_{delta} Balmer Lines," W. Mattig, Monatsberichte der Deutschen Akademie der Wissenschaften zu Berlin, Vol 1, No 12, 1959, pp 723-727)

Experimental Investigations on the Illumination of Interplanetary Matter

General Problem Presentation

Consider a cloud of reflecting small particles floating in space and illuminated by parallel light. If it is sufficiently far removed from us and of reasonable expanse, it will appear star shaped and its total brightness H can be easily determined photometrically. This case is realized in general in the heads of comets. The brightness H can be represented by the following equation:

$$H = \frac{N \cdot A}{r^2 \Delta^2} \varphi(\alpha) \tag{1}$$

where:

$$\left.\begin{array}{ll} N & \text{number of particles} \\ A & \text{reflectivity of an individual particle (albedo)} \\ r & \text{distance cloud-sun} \\ \Delta & \text{distance cloud-earth} \\ \alpha & \text{phase angle} = 180^\circ - \vartheta \ (\vartheta = \text{scattering angle}) \\ \varphi(\alpha) & \text{phase function} \\ \psi(\vartheta) & \text{scattering function} \end{array}\right\} \text{see Figure 1}$$

In this equation the relationships between brightness H and the values N, A, r and Δ are easily seen. These values generally represent physical or geometrical coefficients of measure, known in nature or which can be determined. r and Δ are subject to the square of the distance law. In contrast, the function $\varphi(\alpha)$ or $\psi(\vartheta)$ is completely unknown.

If we are dealing with a particle cloud of large extension, in which possibly our earth is enclosed, it will no longer appear star shaped to us, but instead as a luminous surface of considerable expansion in the sky. This case is realized in the phenomen of the zodiacal light.

Photometric observation in this case provides us with an entire series of brightness points H_1, H_2, ..., H_x over the surface of the cloud (figure 2).

Each brightness point is the integrated light of the cloud along a small visual angle whose size depends on the observation instrument. These points are combined into isophotos in order to describe photometrically the total appearance of the cloud.

The brightness of one such point H_x is obtained from the following equation:

$$H_x = \gamma \int_0^{\Delta x} r^{-2} f(r) \varphi(\alpha) d\Delta . \qquad (2)$$

Since small surface brightnesses are involved in the observation, the value Δ no longer enters into the square of the distance law. γ is a constant.

Brightness H_x must be split up furthermore into an unpolarized and polarized component, since a part of the light is supposedly polarized.

It is seen that in these equations the phase curve $\varphi(\alpha)$ enters decisively into the result. Astrophysicists are making an effort to determine the true spatial and physical properties of these interplanetary formations from the photometric observations of comets and zodiacal light. The main attempt is to determine the density function $f(r)$ and the particle size a. The latter does not occur in our equations, but is included in the phase function $\varphi(\alpha)$ which essentially depends on particle size.

With respect to this phase function there are available to us in the case of large particles the classical phase laws of Lambert and Lommel-Seeliger about diffuse reflection and the moon phase curve. In addition to these we must consider the scattering functions of very small spherical particles in accordance with Mie and others, and finally the scattering law according to Rayleigh and Gans. The repertory of these scattering functions is fully insufficient however, since in part they have been calculated only incompletely and since furthermore it appears questionable whether in practice they should be considered for irregularly shaped bodies. Hitherto, in calculations one proceeded by using the Rayleigh scattering function for particles of the order of magnitude $a \leq 10^{-6}$ cm, Mie's scattering function for $a = 10^{-6}$ to 10^{-4} cm, and one of the classical phase laws for $a > 10^{-4}$ cm.

The need arises to gain insight experimentally into the optical behavior or the phase function of such particles as it would come into consideration for interplanetary space.

For several years we have carried out such experiments in Sonneberg with the aim of determining the phase curves of these particles individually as well as in a group, to investigate the polarizability as a function of the phase angle and to determine the absolute reflectivity.

These physical determinants can quite generally be denoted as the optical material constants of the materials under examination.

In these experiments three different test groups were formed depending upon particle size.

Grout I, Particle Diameter: 10^0 to 101 cm.

For this group a number of meteorites were available, which were largely placed at our disposal by Krinov through the State Meteorite Committee of the USSR Academy of Sciences. A total of 14 stony meteorites and 3 iron meteorites were examined photometrically. The stony meteorites were fragments without a baked crust so that the surfaces should correspond to the interplanetary state. Among the iron meteorites was a piece from the meteorite fall of Sichote Alin, which on impact obviously had been splintered off as a fragment, had remained in dry loess soil until its discovery and had thus remained protected from atmospheric influences. Its dull, metallic glossy and pitted surface should also correspond to the interplanetary state.

The pieces were rotated during measurement in order to form optical mean values concerning various surface elements. Observations of small planets point to the fact that the interplanetary bodies also rotate. The rotational velocity in the experiment (660 revolutions per minute) was adjusted to the time constant of the photoelectric measuring apparatus.

Illumination occurred in parallel light and measurement of the reflected total light was undertaken with an electron multiplier 1 P 21. Polaroid filters and color filters permitted determination of the polarized component and observation in various spectral ranges. The phase angles could be varied between 6^0 and 173^0.

Figures 3 and 4 show typical phase curves for a stony meteorite and an iron meteorite. One recognizes that these curves deviate considerably from the Lambert curve and that in the case of stony meteorites the influence of diffraction modifies the curves quite considerably, starting with phase angles of 140^0, despite the fact that very large bodies are involved. The cause is to be found in the marginal profile of the bodies, whose numerous tiny jags act as deffraction centers at large phase angles.

Figures 5 and 6 show typical polarization curves for iron and stony meteorites. It can be seen that at the maximum the polarized light component can attain a value up to 50%. From the size of the angle of maximum polarization the refractive index of the reflecting surface can be determined according to Brewster's law.

The absolute reflection coefficients of several meteorites in two wavelength ranges are indicated in Table I. They were obtained by photometric extension to a copper plate freshly vaporized with magnesium oxide, whose absolute reflection coefficient was determined directly by the classical method of Lambert /Schoenberg, E. Theoretical photometry. Handb. d. Astrophysik (Handbook of Astrophysics) Vol II, first half, Fundamentals of Astrophysics, 2nd part, 1929, Page 56./

Table I

Absolute Reflection Coefficients of Rotating Meteorites as Well as of Magnesium Oxide and Alabastrite

Mineral	Reflection coefficient at λ 4200 Å	Reflection coefficient at λ 5250 Å
Magnesium oxide	0.984	0.984
Alabastrite	0.706	0.719
Meteorite Norton County	0.221	0.242
Meteorite Nikolskoje-Padenje	0.188	0.203
Meteorite Sichote Alin	0.104-0.192	0.114-0.200
Meteorite Saratow	0.135	0.152
Meteorite Kunaschak	0.120	0.141
Meteorite Perwomaiskij-Posjelok	0.115	0.138
Meteorite Orlowka	0.049	0.060
Meteorite Sevrukovo	0.021	0.039

It should be noted that the reflection coefficients are partly extremely small. That of the iron meteorite of Sichote Alin, too, is small.

Group II, Particle Diameter a $\cong 10^{-2}$ cm

The method and results of this investigation have already been published in detail so that reference should be made to the pertinent publications /Richter, N. in cooperation with W. Oberender and D. Wallis, Experimental investigations on the illumination of dust-shaped clouds. 1st Part: Coarse particles. Veröff. Sternw. Sonneberg (Publications of the Sonneberg Observatory) Vol 12, No 6, 1956; Richter, N. Experimental investigations concerning the illumination of clouds of reflecting particles. Memoires Soc. R. Sc. Liege (Memoirs of the Royal Scientific Society of Liege) 4th Series, Vol XV, Fasc. 1, 1955, Page 807. It should be noted that the particles at any given time were observed floating free in space. Figure 7 shows a specific phase curve of a metallic and a dielectric particle each and in figure 8 the corresponding polarization curves.

Group III. Fine Dusts, Particle Diameter a $\cong 10^{-4}$ cm

The experimental procedure was solved by placing the entire illumination apparatus in a nearly closed chamber in which the dusts (carbonyle-iron drops or powdered quartz type Frechen 200) filled the entire chamber by floating in a very fine dilution. By removal of konimeter samples it was possible to control accurately the number and size of the particles per cm^3. Through a narrow window the illuminated dust bundle was measured at different phase angles using a photoelectric photometer in the photometer room. The measurements were reduced in accordance with specific geometrical ratios conditioned by the experimental set up. The setup permitted measurements in a phase-angle range of 6.5^{o} to 170^{o}.

The results are shown in Figures 9 and 10, in which for comparison sake typical phase curves from the two other particle groups have been recorded. One recognizes the quite significant dependence of these phase curves on particle size, especially for metallic particles. For better comparison, an intensity of 1 for phase angle 0^{o} was used for all curves.

Figure 11 shows the corresponding polarization curves for different particle types. It can be seen that at the maximum a considerable polarization of 15-20% still exists and that the polarization maximum has moved toward smaller angles near the 90^{o} phase angle. Furthermore for metallic particles the polarization curve is still asymmetrical whereas for dielectric particles it has become nearly symmetrical. The final conclusions to be drawn from these experiments should indicate that in the interpretation of photometric observations of interplanetary particle clouds, classical phase laws should under no circumstances be counted upon, and that already for the coarse particles a considerable influence of diffraction at phase angles from 120^{o} to 130^{o} must be expected. For metallic particles of order of magnitude 10^{-4} cm the phase curve has a secondary maximum as is also found in corresponding phase curves according to Mie theory.

Even small particles of the order of magnitude of 10^{-4} cm can produce considerable polarization of the reflected light, so that in explaining observed polarization degrees of interplanetary matter one is not forced into using scattering of free electrons.

Graduate-Physicist Borngen made a substantial contribution in the performance and reduction of these experiments.

The results presented here in abbreviated form will be published in detail in the Veröffentlichungen der Sternwarte Sonneberg (Publications of the Sonneberg Observatory).

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FIGURE APPENDIX

Figure 3. Phase curve of a stony meteorite for mixed and polarized light, compared with the phase curve by Lambert

Figure 4. Phase curve of an iron meteorite

Figure 5. Dependence of polarization on phase angle for an iron meteorite

Figure 6. Dependence of polarization on phase angle for stony meteorites.

1. Meteorite from Kunashak
2. Meteorite from Saratov
3. Meteorite from Norton County
4. Meteorite from Zhovtnevii-Hutor
5. Meteorite from Simmern

Figure 7. Specific phase curves of dielectric and metallic particles of size 10^{-2} cm

Figure 8. Dependence of polarization on phase angle for metallic and various dielectric particles of size 10^{-2} cm

Figure 9. Dependence of phase curves on particle size for dielectric particles.

Figure 10. Dependence of phase curves on particle size for metallic particles

Figure 11. Dependence of polarization on phase angle for particles of size 10^{-4} cm

("Experimental Investigations on the Illumination of Interplanetary Matter," N. Richter, Monatsbereichte der Deutschen Akademie der Wissenschaften zu Berlin, Vol 1, No 12, 1959, pp 727-737)

Red Shift and Limb Effect in the Solar Spectrum

Efforts on the part of astrophysicists to prove the red shift $\Delta\lambda/\lambda = 2.12 \cdot 10^{-6}$ in the solar spectrum, as demanded by the general theory of relativity, have received new impulses during the last few years as a result of observations as well as from theoretical considerations. It is known that the older series of observations made at Mt. Wilson Observatory, Allegheny Observatory and the Bureau of Standards have yielded differences between the relativistic and observed red shift; but only the newer careful series of measurements made in Oxford /Adam, M. G. Interferometric measurements of wavelengths. V. Monthly Notices of R.A.S. Vol 118, 1958, Page 61; see citations listed there for the earlier papers I-IV/ have guaranteed the dependence of the observed red shift on the distance of the measuring site from the center of the solar disc, i.e. the so-called "limb-effect" of red shift, and have at the same time indicated a dependence of red shift, measured in the spectrum of the solar center, on line intensity. The explanation of this finding is possible within the framework of existing solar physics, as the author has shown /Schröter, E. H. On the explanation of the red shift and the center-periphery variation of Fraunhofer lines considering temperature variations of the solar atmosphere. Z. F. Astrophysik (Journal of Astrophysics) Vol 41, 1957, Page 141 = Mitt. Astrophys. Obs. Potsdam (Reports of the Potsdam Astrophysical Observatory) No 50 and "The Current State of Proof of Relativistic Red Shift". Die Sterne (Stars) Vol 32, 1956, Page 140 = Mitteil. Astrophys. Obs. Potsdam (Reports of the Potsdam Astrophysical Observatory) No 51/, if one accepts the existence of relativistic red shift and considers the action of the Doppler effects which are coupled to the solar granulations in order to explain the observed differences and their behavior. In contrast to this, E. F. Freundlich feels obligated to hypothesize a new physical elementary process, in which he questions the existence of relativistic red shift /Freundlich, E. F. and E. G. Forbes. On the red shift of the solar lines. Ann. d'Astrophys. (Annals of Astrophysics) Vol 19, 1956, Pages 183 and 215/.

Newer observations and especially the explanatory efforts by E. H. Schröter (ibid) and E. F. Freundlich (ibid) raise the following questions, answers to which are urgently sought by current new observations. These questions are as follows: What is the accurate behavior of the "limb effect" of metal lines of average intensity as measured by M. G. Adam (ibid) at the outermost periphery of the sun? Especially: is the relativistic value actually reached for sin $\vartheta = 1.00$ or is it even exceeded? Do the form and amount of the "limb effect" display a dependence on the observed line type, as it is required e.g. in Schröter, E. H. (ibid), or are both magnitudes independent of line type, as believed by E. F. Freundlich and E. G. Forbes (ibid)? What in the form of the theoretically stipulated /Schröter, E. H. ibid/ and hitherto empirically only uncertainly substantiated dependence of red shift observed in the spectrum of the solar center, on line intensity? In Spring 1959 the author was able to temporarily conclude an observation program begun in summer 1958 at the Einstein Tower in Potsdam, which as based on these questions, falls into three series of observations. Even though the evaluation of these observations has not been concluded finally, the importance and singularity of the first results occasions us to publish them prior to the eventual conclusion of the work.

Observation series a concerns the last question about the dependence of red shift on line intensity and encompasses the interferometric (Fabry-Perot reference standard with 5-mm plate separation in front of the slit of the large spectrograph of the Einstein tower) connection of the wavelengths of about 100 solar absorption lines to 15 secondary standards in the spectrum of neon and krypton in the wavelength range λ 6080 to 6600 Å. Two discharge lamps (Ne 20, Kr 86) were used as standard light sources, which were lent the author by E. Engelhard of the Physical-Technical Federal Laboratory Braunschweig together with a compilation of wavelengths carefully measured by him (see also Transactions of the International Astronomical Union: Reports of the Commission, Vol 14, 1955 and 1958). Reduction of the measurements occurred in accordance with the method indicated by K. W. Meissner /Meissner, K. W. Interference Spectroscopy I. J. Optic Soc. Amer. Vol 31, 1941, Page 405/. Thus far, absolute wavelengths in the solar spectrum were determined for 36 FeI-lines. The necessary determination of absolute wavelengths in the corresponding laboratory light source required for derivation of the red shift, shall be undertaken in accordance with the recommendations made in Transactions of the International Astronomical Union (ibid) using an Fe-hollow cathode discharge lamp with uranium as getter /see R. W. Stanley and G. H. Dieke. Interferometric wave-lenght of iron from a hollow cathode discharge. J. Optic. Soc Amer. Vol 45, 1955, Page 280/. Since its construction has been delayed we can use our own laboratory wavelengths only in the later final work.

Observation series b determined for the investigation of the limb-effect of average-intensity metal lines, consists of 24 spectrograms in the wavelength ranges λ 6287-6337 Å and λ 6471-6529 Å. By means of the large grating spectrograph four spectra of different sun points were recorded in the 4th order on each plate /see Mattig, W. and E. H. Schröter. Test results on a high intensity diffraction grating with "blaze" action. Optik (Optics) Vol 16, 1959, Page 339 = Mitt. Astrophys. Obs. Potsdam (Reports of the Potsdam Astrophysical Laboratory) No 76/, without touching the photographic plate between individual exposures. Two of these spectra originate from the solar center, the third encompasses the range from $r/r_{\odot} = 0.57$ to

$r/r_\odot$ = 0.62, whereas the fourth spectrum contains the outermost solar periphery of $r/r_\odot$ = 0.79 to $r/r_\odot$ = 1.02. The spectrograph slit was placed radially to the solar periphery and parallel to the polar diameter of the sun. A special arrangement permitted accurate control of the solar picture follow-up. The interferometrically determined wavelengths of solar and terrestrial lines served to derive the dispersion curves for each plate; the terrestrial lines which occurred were used as reference lines to measure the limb effect. Originally blackened spectrograms hitherto common were not used in measurement, but instead the "equidensites" of the solar lines. The equidensites are photographically produced very narrow curves of constant blackening, which are recommended by E. Lau and W. Krug [Lau, E. and W. Krug. "Equidensitometry". Berlin, Akademie Verlag, 1957] for measurement of photographic detail and which had already been used once with good results by the author [Schröter, E. H. Chromospheric structures in Balmer lines. Z. f. Astrophys. (Journal of Astrophysics) Vol 45, 1958, Page 68 - Mitt. Astrophys Obs. Potsdam (Reports of the Potsdam Astrophysical Observatory) No 63]. The application of equidensitometry to our spectrograms simultaneously permits a much more accurate determination of the exact position of the solar periphery from the center-periphery variation of the continuum according to a semi-photometric method than visual estimates had heretofore permitted. The material permits derivation of the limb effect for 30 average-intensity metal lines. For 9 lines reductions have been completed at this time. The recordings of observation series c which serves to investigate the limb effect of strong Fraunhofer lines, are analogous to those of series b with only one significant alteration. This alteration consisted of exposing only a small part of the photographic plate to lighting from the solar spectrum. On the unblackened part of the plate one or more emission lines of a suitable standard light source were depicted by means of the same optical structure (without touching the plate). These emission lines served simultaneously as wavelength standards and as reference lines from which the limb effect of the solar line was measured. This method then permits simultaneous production and measurement in one operation of the equidensites of the emission lines and of the solar absorption lines. It is clear that with the large characteristic width of the strong Fraunhofer lines (0.5 Å to 1 A°) determination of the limb effect with the required accuracy of 1-2 m Å was made possible only by the use of the equidensites. The observation program c encompasses at this time only the two Na D -lines and the Ca-line 4227; additional observations of the Mg-triplet and several strong Fe-lines are in preparation.

Results

Since at this time, as already mentioned, our own laboratory wavelengths for the 36 Fe-lines are not yet available, we have compared their absolute wavelengths in the solar spectrum with those values published in the Transactions of the International Astronomical Union 1955, Table 1 and 2, Page 219. However, corrections had to be applied to the latter values because of the transition from arc in "standard air conditions" to low-pressure or vacuum arc, which were derived in the same manner as done earlier by H. D. Babcock [Babcock, H. D. The effect of pressure on the spectrum of the iron arc. Astrophys. J. Vol 67, 1928, Page 240] (see also Illus. 2 in Stanley, R. W. and G. H. Dieke, ibid) by comparison of the term values from the tables in Transactions of the International Astronomical Union: Reports of the Commission, Vol. 14, 1955 and 1958 (air arc 1 atm.) and from the measurements in Stanley, R. W. and G. H. Dieke, ibid) (Fe-hollow cathode discharge). The result of comparing solar wavelengths with these laboratory wavelengths, i.e. the red shift of these 36 Fe-lines in the spectrum of the solar center is shown in Illus. 1. We have plotted here the difference δ = relativistic - observed red shift as a function of the socalled line intensity W/λ (W = equivalent width in m Å). A variation of difference δ with line intensity can be recognized, although the scatter of individual points is very great, greater than is to be expected from the measurement accuracy. If log W/λ is chosen as variable, a linear representation is obtained:

$$(1) \quad \delta/\lambda \cdot 10^6 = + 2.46 - 1.32 \log (W/\lambda \cdot 10^6)$$

These results further show the necessity of including the strong and strongest lines in these observations in order to establish this conformity with law over the entire range of line intensities realized in the solar spectrum. In this sense observation series a requires an expansion.

The results of observation series b, i.e. the limb effect of nine average-intensity metal lines measured by us, are shown in Illus. 2, in which we have also plotted the older measured points by M. G. Adam (ibid). We wish to refer to three new characteristics of our limb-effect curve. 1. From $\cos \vartheta = 1.0$ to 0.8 a slight decrease in red shift occurs, which we must consider as real. 2. From $\cos \vartheta = 0.6$ to $\cos \vartheta = 0.2$ the measurements show a practically linear behavior (over $\cos \vartheta$. Dr. M. G. Adam kindly informed the author that her latest observations on 3 Fe-lines also indicate linear behavior), where at the exact solar periphery after easy extrapolation the red shift exceeds the value in the solar center by 8 to 10 m Å. 3. Since these lines posses on the average a red shift of 6 m Å in the solar center, the (extrapolated) range from $\cos \vartheta = 0.2$ on, yields extrarelativistic red shifts.

The result of observation series c is especially informative:

The two Na D-lines, except for small local and irregular variations in wavelength, show no authentic limb effect. These local variations in wavelength, which we would like to attribute to the chromospheric or photospheric Doppler effects (see Schröter, E. H. Chromospheric structures in Balmer lines, ibid) have an average value of $\pm$ 2 m Å and therefore make it impossible to establish an eventual very weak limb effect of the same value.

The extension-emission lines Ne 5881.8950, Kr 5870.9127 and Kr 5879.9880 yielded the values:

5889.966 Å and 5895.938 Å

for the absolute wavelengths of the two Na-lines in the spectrum of the solar center.

As known, the laboratory wavelengths of the two lines are:

5889.954 Å and 5895.927 Å

so that on the average a red shift of = 11.5 m Å follows. This is in good agreement with the relativistic value of 12.5 m Å, especially if one considers the irregular variations of the solar wavelengths. To this result we wish to add that the measured equidensites of the two Na D-lines corresponded to a relative intensity of about 20% of the continuum, so that our assertions are based on the internal cores of the two lines.

The small extra-relativistic red shifts which resulted during the limb effect of the average-intensity lines at the outermost solar periphery, are difficult to explain on the basis of assumptions hitherto made from the standpoint of the theory advanced in Schröter, E. H. On the explanation of red shift ... ibid; the behavior of the Na D-lines, on the other hand is entirely in accord with the author's predictions made in the above paper.

Details concerning the interferometric apparatus, the measuring and reduction technique will be published in a comprehensive paper as soon as the reduction of the entire material is completed.

Received: 31 August 1959

FIGURE APPENDIX

Figure 1. Dependence of difference δ between relativistic and observed red shift on line intensity $W/\lambda \cdot 10^6$ (the curve corresponds to the linear presentation in equation (1) with log $(W/\lambda \cdot 10^6$ as variable)

Figure 2. The "limb effect" of average-intensity metal lines. Dark curve (with limits) = Potsdam measurements of nine lines (with actual uncertainties); dashed curve = extrapolation or interpolation of the measurements; * the older, interferometric measured points by M. G. Adam with the actual uncertainties.

("Red Shift and Limb Effect in the Solar Spectrum," E. H. Schröter, Monatsberichte der Deutschen Akademie der Wissenschaften zu Berlin, Vol I, No 12, 1959, pp 738-744)

IV. OCEANOGRAPHY

A Soviet Innovation for Deep Underwater Oceanographic Research

The following is the complete text of a TASS dispatch of 3 March 1960 reporting new equipment for underwater exploration.

"An underwater apparatus for research at great depths in the ocean -- a diving bell (batiskaf), has been devised by the youthful Leningrad specialists M. Diomidov and A. Dmitriyev. This apparatus is designed for submergence to a depth of 11½ kilometers."

"The apparatus is a metal cigar-shaped floater 17 meters long and 4 meters in diameter. The bottom part is a spherical chamber for holding two researchers and scientific instruments. The walls of the sphere will be manufactured from steel alloy 15 cm thick. During submergence the gasoline filling the floater will be compressed by the water. This will insure the even and slow submergence of the diving bell and will bring internal and external pressure on the walls of the cigar-shaped floater into equilibrium; this will keep the apparatus from being crushed.

The diving bell designed by the Leningrad specialists is a freely-floating apparatus. It will be connected to the ship by a telephone line. Two small electric motors with propellors will enable it to move in the water at any depth. ("Soviet Diving Bell". Pravda, 4 March 1960, p. 6)

Chinese Study of the Bottom of the East China and Yellow Sea

The following is the Russian abstract of an article appearing in a Chinese oceanographic publication. The abstract was obviously written by a Chinese with imperfect command of Russian vocabulary and composition. The English translation of the Russian abstract can therefore be accepted as accurate with some limitations. Placenames have been transliterated into English from the Russian. The original text contains no map to assist in the identification of places mentioned. The National Geographic Society 1:3,500,000 1953 map of the China Coast was consulted, but no immediate identification of the places mentioned has been made.

During the joint research conducted by scientists of the China People's Republic and the USSR in the period between 31 December 1957 and 17 February 1958 in the area of the East China Sea bottom samples were taken by use of an "Okean-50" bottom dredge. These samples were dispatched for analysis to the marine geology working group of the Institute of Oceanology.

The marine geology group used the classification method developed by the Soviet marine geologist M. V. Klenov for the classification of the results of analysis; this method was used to make a preliminary compilation of a bottom map of the East China Sea and the southern part of the Yellow Sea.

The widespread marine bottom deposits of the East China Sea and the southern part of the Yellow Sea are continental sediments. Jointly with this accumulation there is deposited material from the mainland of China of a mineral composition; part is material eroded from steep shores by the waves, but it is chiefly material carried into the sea by rivers. The mouth of the Yangtze River is considered the boundary between the East China Sea and the Yellow Sea.

To the north of the Yangtze River mouth the coastal zone of Tszyansu is broad, with a depth of approximately 20 m., often encountered on the sea bottom and sandy accumulations and shoals: Dasha, Baysha, Lansha, Pudzha, Tszindzha and others. These shoals are a great hindrance to navigation and a danger to ships. From this point northward along the coasts of the Shantung Peninsula the shoal area becomes narrower, curves, and is replaced by rocky shores. Encountered in these sandy belts are scattered cinnamon-colored spots of clayey silt; from here eastward there are cinnamon-colored spots which result from depositional material from the mainland. From the sandy belt eastward, at a depth of 20 meters, there is a gradual change; there are silty-sandy places, yellow-grey to black in color. One black spot of clayey silt has been discovered on the eastern part of Tyankhyn Island; westward from this point there is a belt of clayey silt at depths of 60 to 80 m. Parallel to the shore the bottom color is grey to yellow, the fraction is uniform and very fine; from the eastern part of Chinshantao southward, to Tyankhyn Island, it becomes deeper. To the north of the East China Sea and in that part of the sea to the east of the mouth of the Yangtze River, the clayey silt is almost uniform. In this region there are silty belts of black and dark grey color, uniform in size and containing a small amount of sand; in the vicinity of the eastern part of Tszyaoch-zhouwan the silty belt passes into the sandy silt bed of that region.

To the south of the Yangtze, that is, in the region of the East Dhina Sea, the water is deeper, the bottom is siltier and farther from the shore the bottom is sandy. Near the mouth of the Chentantszyan and to the north of the Yangtze River the sea bottom is sandy, but near the mouth of the Usunkao there are shoals: Yagaosha, Khynsha and Tunsha; in the valley of the Yangtze, at the mouth, there is a great shoal, called the "Yangtze Shoal".

In the investigated region, in the southeastern corner, the bottom is sandy, grey-yellow or light grey in color; on the margins of the region of sandy silt the sand contains a great amount of silt. On the basis of the foregoing composition, as analyzed on a preliminary basis, the sediments of the Yellow and East China Seas have been formed on the sea bottom primarily from the alluvium carried into the sea by rivers. To the north of the Chinese Gulf of Khan'chzhou the mountains of the mainland for the most part are oriented perpendicular to the sea. In addition, there is a very great number of tributaries and the rivers themselves are long: Liao-ho, Hai-ho, Hwang-ho and Hwai-ho.

Extending in a northeast-southwest direction in the East China Sea, from the shore to considerable depths, there is a sandy bottom which appears to be chiefly under the influence of a warm current with a very rapid flow. Therefore the fine bottom material in this region has been carried away completely and only large particles remain; along the shore there is a sandy bottom which is also under the influence of incoming and outgoing tides and their currents; for example, near the mouth of the Chentantszyan River there is a sandy bottom formed under the tidal action of Khan'chzhou Gulf. In the northern part of the Yellow Sea there is finer silty-sandy bottom material, forming chiefly under the influence of gentle tidal currents. There is no question but that the control of the distribution of sediments in the East China Sea and the southern part of the Yellow Sea also depends on a number of other secondary factors which remain to be studied in greater detail in the future. ("Preliminary Study of Bottom Material of the East China Sea and the Southern Part of the Yellow Sea", by Fang Shih-ch'ing and Ch'ing Yun-san, Oceanologia et Limnologia Sinica, vol. 2, no. 2, 1959, pp. 84-85)

New Books on Soviet Oceanographic Research

Two new books on Soviet Oceanographic research were recently issued. One of these, Berega Beringova Morya (Shore of the Bering Sea), was issued by the Institute of Oceanology, Moscow, in 1959. The book contains a generalization of the results of the investigations on the expeditionary ship, "Geolog" (1951-1954) and also literature and cartographic materials concerning the structure and dynamics of the coastal zone of the Bering Sea. The book contains 358 pages with illustrations as well as insertions and a map.

The second, Trudy Instituta Okeanologii, I. XXXIII, Problemy Khimii Morya. (Works of the Institute of Oceanology, Vol 33, Problems of Chemistry of the Sea), Moscow, 1959, is a 210 page illustrated book concerning studies on the origin of the minimum oxygen layer and the laws of its disposition in the ocean, the biogenic elements of the upper water layers of the Bering Sea, the chemical composition of mud-waters from the Pacific Ocean, etc. ("New Books"; Vestnik Akademii Nauk SSSR, No 1, Jan 1960, p 130)

V. ARCTIC AND ANTARCTIC

A Three-Month Report of Soviet Antarctic Activities

The Chief of the Soviet Continental Expedition, A. G. Dralkin, has reported the following by radio from Antarctic stations for March, April and May 1959.

March

Mirnyy observatory. Aerological research. In March 1959 the mean value for atmospheric pressure at the earth's surface was 986.8 mb, air temperature -8.9°, wind velocity 11.8 m/sec., relative humidity 74%. The overall cloudiness was 7.1. The mean height reached by radiosondes was 21,000 m.

During the month of March air temperature varied from 2.1° to -18.9°, the total precipitation was 58.3 mm., the number of days with snowstorms was 18.

A successive alternation of meridional and zonal atmospheric circulation was noted in the Indian Ocean sector of Antarctica in March; zonal circulation at the beginning of each 10-day period preceded meridional circulation. In accordance with this circulatory regime jet streams were observed aloft on three occasions; the maximum wind point there is a belt of clayey silt at depths of 60 to 80 m. Parallel to the shore the bottom color is grey to yellow, the fraction is uniform and very fine; from the eastern part of Chinshantao southward, to Tyankhyn Island, it becomes deeper. To the north of the East China Sea and in that part of the sea to the east of the mouth of the Yangtze River, the clayey silt is almost uniform. In this region there are silty belts of black and dark grey color, uniform in size and containing a small amount of sand; in the vicinity of the eastern part of Tszyaoch-zhouwan the silty belt passes into the sandy silt bed of that region.

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A successive alternation of meridional and zonal atmospheric circulation was noted in the Indian Ocean sector of Antarctica in March; zonal circulation at the beginning of each 10-day period preceded meridional circulation. In accordance with this circulatory regime jet streams were observed aloft on three occasions; the maximum wind velocity in the jet streams exceeded 80 m/sec. High wind velocities were observed in a jet stream of south-southwesterly direction in a high polar ridge connected with the New Amsterdam anticyclone (with a pressure of about 1030 mb in the center).

The intensification of the jet stream was caused, on the one hand, by the approach of a cyclone from the west and, on the other hand, by the southward movement of a near-stagnant low situated to the north of Wilkes station.

Thus, the block thus formed (polar ridge -- New Amsterdam anticyclone) forced the cyclones moving from the Atlantic sector to pass somewhat to the south. The approach of a cyclone to the coast of the continent was accomplished by the drawing out of warm air and the development of a high polar ridge.

Geophysical work. A disturbed state of the magnetic field was observed at the beginning and end of the month. A small increase in activity was noted between 1 and 12 March. The number of calm days in March was almost twice as great as in January and February combined. The number of days in March with a mean index of $k < 3$ was ten, in February two, in January four. The results of magnetic field measurements along the route Mirnyy-Komsomol'skaya were processed. In the vicinity of Pionerskaya a number of anomalies of small extent were discovered, which are possibly suitable for the computation of the depths of the base of the subglacial relief.

The state of the ionosphere was less disturbed than in February. The critical frequencies of the F_2 layer increased to 10-11 mc. The lifespan of the F_1 layer continued to decrease; it was observed from 0900-1000 to 1500-1600 hours local time. The critical frequencies of the E-layer decreased; they did not exceed 3.5 mc. In the first half of the day a sporadic C-type layer appeared with a screening of higher layers, in the evening -- an H-type layer, at night and in the morning -- a sporadic F-layer, but with sharper screening than in February.

The minimum frequencies possessed a constant variation -- they increased by day and dropped at night, not exceeding 2 mc. when on disturbed days. A disturbance was observed between 27-30 March and was characterized by sharp decreases in the critical frequencies with complete absorption (28 March, between 0300 and 0800 hours Greenwich time) of the deviating region.

Visual observations of auroras were made. Beginning on 15 March regular round-the-clock radar observations of auroras were made.

Glaciological research. Seven holes were drilled with a total depth of 192 m (at Mirnyy -- to 8, 12 and 18 m., on Drigalskiy Island -- two to 60 m., on the Shackleton shelf ice -- to 5 and 29 m.). Temperatures were measured in two drill holes on Drigalskiy Island and in a 64-meter deep hole in the vicinity of Mirnyy measurements were made with mercury and resistance thermometers; these demonstrated the reliability of work with a four-wire circuit. A thermogradient apparatus was manufactured and calibrated. Seismic sounding was used to make an incomplete measurement of the thickness of the Shackleton shelf ice to the east of Mill Island.

The intersection of signal lights on Drigalskiy Island was tested for the first time for determination of the speed of melting of the ice cupola. First attempts were made at making heliotropic observations from the cupola on Drigalskiy Island and the intersection of points in the daytime was shown to be feasible. An apparatus was devised for the supersonic investigation of ice. Two complex snow measuring observations were made and work was completed on the preparation of an undersnow laboratory for the study of the mechanics of ice, snow and firn.

Attempts were made to determine the coefficient of viscosity and the modulus of elasticity of ice forming on the wings, tail surfaces and propellors of aircraft. Compression tests were made of samples of snow from Drigalskiy Island and compression curves were drawn for the first two stages of loading; stratigraphic observations were made for the determination of instantaneous cohesion and density on peripheral parts of Drigalskiy Island; determinations were made of the thickness of annual layers of instantaneous cohesion and density on Mill Island cupola and the young Shackleton pack ice; on the thick Shackleton shelf ice determinations of long-range cohesion were made under natural conditions.

Hydrological research. Two flights were made for the purpose of ice reconnaissance of the Davis Sea. Daily panoramic photo surveys were begun for the systematic observation of the formation of young pack ice in the vicinity of Mirnyy. An instrument was prepared for operation from the pack ice for the measurement of the mean velocity of flow, the vertical and horizontal components of its velocity, the mean temperature of the water and its pulsation; two calorimeters were used to study the flow of heat from the bottom and from the ice cover.

Vostok station. In March 1959 the mean values for atmospheric pressure at the earth's surface was 626.1 mb, air temperature -52.9°, temperature of the snow surface -55°, relative humidity 78%, total precipitation 12.1 mm. Overall cloudiness was 3.6. The mean height of radiosonde observations of the atmosphere was 20,717 m., while pilot balloons rose to a mean height of 20,266 m. The mean height of the tropopause was 8,453 m. The maximum air temperature was -37.7° and the minimum was -67.4°.

The great amount of precipitation was due to strong inflation during snowstorms. The prevailing wind direction was westerly and southwesterly.

The mean wind velocity was 6.7 m/sec., with a maximum of 13 m/sec. There were snowstorms during a large part of the month with a sharp decrease in horizontal visibility.

The ionosphere station was in constant operation. Over a period of a month there was a gradual drop in the critical frequencies of the E-layer, right up to complete disappearance at night. The F_2 layer was almost constantly diffuse. The minimum density of ionization of the F_2 layer was noted at about 1700-1800 hours Greenwich time. Trial photo surveys of auroras were begun at the end of the month.

Komsomol'skaya station. Closed temporarily on 8 March 1959.

Lazarev station. The station was opened on 10 March 1959. Regular observations were begun in the fields of meteorology, actinometry, terrestrial magnetism and aerology. The mean value for atmospheric pressure at the earth's surface was 977.8 mb, air temperature was -11.3°, wind velocity was 13.2 m/sec., relative humidity was 82%. Overall cloudiness was 7.4. The mean height of radiosonde observations was 15,970 m., while the height to which pilot balloons rose was 10,640 m. The maximum air temperature was -2.3°, minimum -27.3°.

The prevailing wind direction was easterly and southeasterly. The maximum wind velocity was 57 m/sec. On nine days there were winds of gale force, four of which showed winds of hurricane force. Over a 21 day period the thickness of the snow cover in the vicinity of the station increased by 24 cm.

<u>April</u>

At Mirnyy observatory. Aerometeorological research. In April 1959 the mean values at the earth's surface were: atmospheric pressure -- 985.5 mb, air temperature -- -12.6°, relative humidity -- 70%. The overall cloudiness was 6.3. The total precipitation was 10.6 mm., while the mean height of radiosonde observations was 23,200 m. During the month the air temperature varied from -1° to - 24.4°.

Zonal atmospheric circulation predominated in April in the Southern Hemisphere. During the two preceding fall months there was a sharply expressed meridional circulation of the atmosphere. An even cooling of the air took place from the high latitudes to lower latitudes; this could not but be expressed in a weakening of the temperature contrast between subpolar and subtropical regions. Data for stations in the equatorial belt of the Pacific Ocean, Indian Ocean and Atlantic Ocean sectors show that relatively cold air was spread out to the equator. An analysis of a time profile shows that cyclones for the most part moved from west to east in April.

The winds in the troposphere were predominantly weak and changed in direction from the western quarter to the eastern quarter, corresponding to the passage of cyclones. Jet streams with a southwesterly direction were observed; they were associated with the movement of a cyclone from the region to the southwest of Kerguelen Island toward Mirnyy. The lifetime of the jet streams was 12 hours; the maximum wind velocity at the tropopause level was 60 m/second.

About 24 hours passed between the moment of the change of direction of the jet stream from southwest to west-northwest and the beginning of snowfall at Mirnyy. The appearance on 28 April of a jet stream of a different type, southeasterly in direction, with an air velocity at the tropopause level of more than 60 m/sec., and an increase in the height of the tropopause by 3 km., was caused by the influence, on the one hand, of the polar anticyclone, and on the other hand -- by the trailing part of a cyclone situated in the vicinity of Wilkes station.

In addition to jet streams in the troposphere, jet streams were twice observed in the stratosphere in April.

Geophysical research. The magnetic field was relatively calm in April. The characteristic increase in activity in the morning hours (Greenwich time) appeared to be weaker than in January and February. In the evening hours there was frequently a sharp increase in activity, continuing about an hour. The general state of the ionosphere in April was calm.

A small disturbance was observed on 9 April; it was expressed in a decrease in critical frequencies in the F_2 layer and the initiation of complete absorption in 2 hours. A deviation from the normal state also occurred on 24 April when there appeared a sporadic layer of the A-type, screening all higher layers. For the period of an entire month there was an increase in the critical frequencies of the F_2 layer to 12-14 mc. This layer was very diffused at night. The lifespan of the F_1 layer decreased sharply. The layer was observed for a period of 1-12 hours; its critical frequencies did not exceed 3-3.1 mc. There was an increase in the number of cases of the appearance of sporadic layers with a partial screening of rigions lying above. Two maxima were noted in the diurnal march of the number of radio reflections from auroras; these were at 0300 hours and (more weakly expressed) at 0700 hours Greenwich time. The greatest number of reflections was noted 500-800 km to the northeast of Mirnyy.

Forty earthquakes were recorded in April. Epicentral distances (from 6,000 to 9,000 km) were determined for six of them.

Glaciological research. Three holes were drilled at Mirnyy and on the Shackleton ice shelf. Seismic sounding was accomplished on the Shackleton ice shelf and precise reflections were received of the contact between ice and water. Hydrographs of refracted waves were drawn for the upper layer of the shelf ice.

Seismic sounding was accomplished in the central part of Drigalskiy Island for determination of the mean velocities of elastic waves in the ice mantle. On the Shackleton shelf ice seismic core sampling was accomplished in a 32-meter hole. A series of investigations was made on Drigalskiy Island, the Shackleton shelf ice and in the vicinity of Mirnyy for the study of the thermal and mechanical properties of the ice and snow.

The thickness of the pack ice was measured on a systematic basis.

Vostok station. The mean values at the earth's surface were: air temperature -- -61.8°, atmospheric pressure -- 627.6 mb, wind velocity 5.6 m/sec., relative humidity -- 75%, temperature of the snow surface -- -64.4°. Overall cloudiness was 4.3. Total precipitation was 5.9 mm. Prevailing wind direction was west-southwest. Three snow surveys were made in open areas. Mean density of snow was 0.3 g/cm^3.

Thirty radiosonde observations and an equal number of pilot balloon observations were made. The mean altitude to which the radiosondes rose was 19,211 m., for the pilot balloons this figure was 18,950 m.

Ionosphere observations were made on a continuous basis. The E-layer was observed in the limits of the station's frequency range over a period of 10-12 hours; the rest of the time the critical frequencies were less than 1 mc or the E-layer disappeared completely. By the end of the month there was a weakening of the sporadic layers. Auroras with an intensity greater than 1.5 were observed on 14, 15 and 16 April; auroras with an intensity of 1.0 or less -- on 8, 9, 13, 19, 30 April. The color of the auroras was always whitish.

Observations of terrestrial magnetism were made. Over a period of a month there were 14 calm days, 13 moderately disturbed days and 3 disturbed days. Two magnetic storms were observed: 9-10 April with an amplitude up to 690 γ and 23-24 April with an amplitude up to 326 γ.

Lazarev station. The mean values at the earth's surface were: atmospheric pressure 985.1 mb, air temperature [there is an obvious typographical error here, with one or more lines omitted] relative humidity (?) -- 84%, wind velocity -- 21.3 m/sec. Overall cloudiness was 6.9. Temperature of the snow surface was -14.0°. Total precipitation was 3.2 mm. The mean height reached by radiosondes was 20,480 m.

May

Mirnyy observatory. Aerometeorological work. In May the mean values at the earth's surface were: atmospheric pressure -- 984.5 mb, air temperature -- 13.7°, wind velocity -- 13.5 m/sec., relative humidity -- 78%. Overall cloudiness was 7.1. The mean height of radiosonde observations was 19,000 m.

During the month the air temperature varied between -4.3 and -27°. There were 27 days with snow storms. Maximum wind velocity was 43 m/sec. Of great interest are measurements made by snow-melting apparatus: over an 18-day period in an area with a 1-meter base and a height of 3 meters and with a mean wind velocity of 13 m/sec., the movement of 65,926 kg of snow was recorded.

The first 10 days of May was characterized essentially by zonal circulation of the atmosphere. A cold and relatively stagnant low was situated over the region of Mirnyy; new active cyclones moved from west to east along its northern edge. One of them caused a brief snowfall in the middle of the ten-day period.

In the upper troposphere the approach of the cyclone mentioned was preceded by the appearance of a jet stream with a southwesterly direction and an increase in the height of the tropopause by 2.5 km.

The maximum wind velocity in the jet stream in the troposphere was 40 m/sec. During the first 10 days winds in the troposphere essentially dominated the eastern quarter with a velocity of 4-12 m/sec. Winds in the lower troposphere were observed from the western quarter with a velocity of 12-16 m/sec., with the exception of the earlier mentioned case associated with the approach of a cyclone. In this case a stratospheric jet stream preceded the jet stream in the troposphere.

In the second 10-day period zonal circulation was maintained in the subpolar zone of the Indian Ocean. However, cyclones moving from west to east curved around the nearly stagnant low in the vicinity of Mirnyy somewhat farther to the south than in the first 10-day period. This evidently accounts for the appearance of western quarter winds in the middle and upper troposphere with a velocity of 1-12 m/sec (with the exception of a powerful jet stream of a southwesterly direction, observed at the beginning of the second 10-day period and associated with the approach of a cyclone in the vicinity of Mirnyy). Its maximum velocity in the troposphere was about 70 m/sec.

Toward the end of the second and in the course of the third 10-day period, in the vicinity of Mirnyy and to the north of it, we observed an extensive cyclonic zone which was blocked by a powerful stationary Australian anticyclone combined with a polar ridge in the vicinity of Wilkes Land. In the third 10-day period there were eastern quarter winds throughout the troposphere with prevailing velocities of 20 m/sec., and maximum speeds greater than 40 m/sec.

The first series of cyclones in the middle of the third 10-day period was concluded by an intensification and movement of the polar anticyclone from the east toward Mirnyy. The passage of cyclones over Mirnyy was usually preceded by a characteristic stratospheric jet stream; this fact makes it possible to predict the deterioration of weather in advance.

In May the thickness of the stratospheric jet streams varied from 6 to 12 km with maximum velocities from 50 to 70 m/sec. at heights of 19-21 km.

Geophysical research. The magnetic field in the first 10-day period of May was relatively calm. A magnetic storm was observed between 1-14 May; on 12 May it attained maximum intensity and was accompanied by complete disruption of radio waves and by bright auroras. We began a regular recording of short-period variations of the magnetic field by use of LGU magnetometers with paper moving at the rate of 6mm/min and with the value of a graduation about 1 γ/mm.

At the beginning of the month the ionosphere was calm, with the critical frequencies in the F_2 layer from 2 to 10 mc, after which complete absorption set in. Toward the end of the day everything became calm. At 0300 hours on 11 May complete absorption again set in, continuing to the second half of the day on 14 May.

The disturbance, expressed by an increase in minimum frequencies and from time to time by the setting in of complete absorption, also continued during the next three days. A small disturbance, expressed by a decrease in critical frequencies in the F_2 layer, was observed on 25 May.

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Auroras with a brightness of 3 were observed on 11 May, with a brightness of 2 on 13 May and a brightness of 1 on other days.

In May 57 tremors and earthquakes were recorded, for 8 of which the epicentral distances were recorded at distances of between 3,000 and 9,000 km. Two very distant earthquakes were recorded with epicentral distances of 15,000 km.

Glaciological research. Two bore holes were drilled, with depths of 12 and 30 m, 7 km from Mirnyy. Temperature was measured in a hole at a range of depths between 15 and 150 m.; a survey was made of the thickness of the snow cover; the cohesion value for the snow surface was determined, as was the density of the snow in the holes; work was carried on to determine the modulus of elasticity of ice; experiments continued for determining the coefficient of viscosity and other physical-mechanical properties of ice. The speed of movement of the glacier was measured in the vicinity of Mirnyy.

A group of glaciologists and geomagnetic specialists accomplished all-around glaciological and geodetic research on Dirigalskiy Island. During the month gravimetric teams used Penguin cross-country vehicles for continuation of all-around research in the deep continental interior and in the sector between Mirnyy and Pionerskaya.

An ice reconnaissance was made of the Davis Sea. A flight was made in an LI-2 aircraft to the Australian station Wilkes to render assistance to a sick polar specialist. ("By Radio from Antarctica," Byulletin' Sovetskoy Antarticheskoy Expeditsii, No. 9, pp. 48-50, No. 10, pp. 34-35; No. 11, pp. 46-48 (1959))

A New Soviet Measurement of the Earth's Crust in Antarctica

The principal sources of information about the deep structure of the earth's crust are seismological data, deep seismic sounding and gravimetry. It is well known that the density of the upper layers of the substratum is approximately 0.4 g/cm^3 greater than the earth's crust. Therefore in those places where the substratum is situated closer to the surface of the geoid, the acceleration of the force of gravity in the Bouguer reduction will have a greater value. On the other hand, in those places where the thickness of the earth's crust is great (and, consequently, the substratum is situated deeper), one observes a negative anomaly of the force of gravity (in the Bouguer reduction).

On the basis of considerable gravimetric data it has been established that highlands are usually characterized by considerable (from 150 to 550 mgl) negative Bouguer anomalies. Lowlands and low plains usually have anomalies in the range ±50 mgl. Shelf regions are essentially characterized by weak (up to 100 mgl) positive anomalies. For deep water zones (300 m and more) Bouguer anomalies on the order of 200-450 mgl are characteristic.

We have received our first data concerning the gravitational field of Eastern Antarctica. In addition we have sufficiently reliable determinations of the thickness of the ice along the profile Mirnyy-Pionerskaya and echo-sounding measurements of the depths in Davis Sea. This has made it possible to compute Bouguer anomalies along the meridional profile between the Davis Sea and Pionerskaya. The density of sea water in computations was assumed to be 1.03, that of ice -- 0.9, and that of the earth's crust -- 2.84. Anomalies for the sections of the profile covered by continental ice were computed only for those points for which we had seismic data on the thickness of the ice. In the sector Mirnyy-Km. 245, we used the seismic data on the Second Continental Expedition, supplied by O. K. Kondrat'yev; in the sector between Km. 245 - Pionerskaya, the data of the Third Continental Expedition was used. When computing Bouguer anomalies we took into consideration the attraction of the ice situated above sea level; depending on whether or not the underlying bed was situated below or above sea level, a "fill" was made to sea level by fictitious masses with a density of 1.76 or the influence of excess material was taken into account, also assuming their density to be 1.76.

On the basis of preliminary estimates of the accuracy of gravimetric data (± 10-15 mgl), seismic and echo sounding data (± 50 m), and also the assumed density characteristics, we may assume our Bouguer anomalies to have an accuracy on the order of ± 20 mgl.

The marine depressions surrounding the Eastern Antarctic are characterized by a thick layer of sediments whose density may be assumed to be close to 2.3. Considering this factor for geological anomalies in the sector of the profile between Km. 100-200 in the Davis Sea, we get somewhat greater values than for a Bouguer anomaly.

By using the values of Bouguer anomalies for the entire profile, it is possible to divide it into three sections: 1) 200-100 km of the Davis Sea -- a region of transition from a typically oceanic crust to a shelf zone (geomorphological continental slope); 2) km 100 in the Davis Sea to km 50 between Mirnyy and Pionerskaya -- a shelf zone; 3) km 50 between Mirnyy and southward -- a zone of platform lowlands and low plateaus.

Recently a number of attempts have been made, by means of comparison of seismic and gravimetric data, to determine what mean thickness of the crust corresponds to a zero Bouguer anomaly. The following results were received:

B. A. Androyev in 1958	30 km
I. N. Kropotkin and others in 1958	38 km
Dzh. L. Uorzel and G. L. Sherbet in 1954	33 km

Inasmuch as there are still no seismic determinations of the thickness of the earth's crust in the vicinity of the profile Davis Sea-Pionerskaya, it has been assumed that a zero Bouguer anomaly corresponds to a thickness of the earth's crust of 33 km.

The difference in the density "crust-substratum" was assumed to equal 0.4. Computations were made by a formula for an infinitely plane-parallel layer. Using the Mohorovicic boundary thus derived, we made a control determination of the Bouguer anomaly by use of a Gamburtsev overlay; this gave a good correlation between computed data and the initial values of the anomalies.

The Mohorovicic boundary as we determined it is only a first approximation to the true one, because we know nothing about the deep structure of the crust. Therefore it is very important to conduct deep seismic sounding in this region.

It is probable that the greatest deviation of the configuration of the derived Mohorovicic boundary from its actual position will be in the transitional zone from a crust of continental type to an oceanic type crust. Nevertheless we can delineate this zone with confidence because the crustal thickness therein decreases rapidly from 30 to 15 km. It may also be noted that there is a gradual increase in the crustal thickness from the coast toward the heart of the continent. In the vicinity of Mirnyy it is about 32 km, at Pionerskaya -- 37 km, and at Komsomolskaya -- about 40 km. It can be stated with confidence that Eastern Antarctica has a continental type crust.

In the interior of the continent there are zones where the rock bed is situated below sea level under a thick layer of ice. Before glaciation they were probably low plains and have now subsided as a result of isostatic sagging of the earth's crust under the weight of the ice. ("Thickness of the Earth's Crust Along a Meridional Profile From the Davis Sea to Pionerskaya Station," by S. A. Ushakov and G. E. Lazarev, Byulletin' Sovetskoy Antarkticheskoy Ekspeditsii, No. 10, 1959, pp 9-12)

Current Measurements on a Coastal Sector of the Davis Sea

In 1957, during the period of the Second Continental Expedition, observations were made of currents on the coastal part of the Davis Sea (points of observation are shown in Figures 1 and 2). Currents were measured from the pack ice at depths of 10 and 25 m. Observations were processed by the method of harmonic analysis -- partly by the Darwin method and partly by the Admiralty method. The results of observations are given in Tables 1 and 2. ("Concerning Currents on the Coastal Sector of the Davis Sea," by N. P. Shesterikov, Byulletin' Sovetskoy Antarkticheskoy Ekspeditsii, No. 10, 1959, pp. 24-28)

Aeromagnetic Work Yields Striking Results Near Mounts Gauss and Brown

Until aeromagnetic work was accomplished in the vicinity of Mount Gauss in 1957, there had been only extremely limited information available about the geological structure of the sector between Mount Gauss and Mount Brown. These peaks were assumed to be completely independent of one another because their rocks were of different ages. These outcrops appear in only a small area and until now our ideas have been based on interpolation rather than on adequate data.

Aeromagnetic work in this region was limited to a relatively narrow zone near the coast of the continent, approximately from 66°30' to 67°00' S. The surveys were made by the geophysicists Yu. S. Glebovskiy and A. M. Karasik in a LI-2 aircraft. Measurements of the magnetic field were made at a scale of 1:500,000. Control was generally poor, with errors of several kilometers in places. Flights were made at an altitude of 600 m.

Despite the several inadequacies in the work, the resulting map of isolines of ΔT enables us to derive important and well founded conclusions about the geological structure of the studied area. This map in simplified form and at a reduced scale is shown in Figure 1. There is a northeast-southwest zone of magnetic anomalies passing through the entire region. The peculiarities of the magnetic field here can be due only to Archaean rocks near the surface. The most intense anomalies are doubtlessly due to basic rocks.

The aeromagnetic survey established that the rocks making up Mount Gauss are practically nonmagnetic.

Figure 2 shows a schematic map of the Brown-Gauss region.

The conclusion drawn on the basis of this survey is that there is a subglacial and submarine range here -- a horst -- made up of rocks predominatly of Archaean age.

The aeromagnetic survey has brought together a series of earlier known disconnected facts and makes it possible to delimit the Brown-Gauss region as a single zone of uplift of ancient rocks. Gauss volcano and Mount Brown prove to be only individual phenomena in a large-scale geological structure whose existence was unknown before aeromagnetic work was accomplished. ("The Brown-Gauss Subglacial Range," by Yu. S. Glebovskiy, Byulletin' Sovetskoy Antarkticheskoy Ekspeditsii, No. 10, 1959, pp. 13-17)

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